

***Porites arnaudi*, a new species of stony coral
(Anthozoa: Scleractinia: Poritidae) from oceanic islands of the
eastern Pacific Ocean**

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Abstract.—A new species of *Porites* (*P. arnaudi*) was found at depths of 7 to 37 m at Clipperton Atoll, France, and the Revillagigedo Islands, México, oceanic islands located west of the American mainland (eastern Pacific). Colonies are uncommon but very distinctive because of the presence of tiered plates, or laminae, expanding from a single base, smooth and concave surfaces, and a lack of living tissue on the inferior part of the plates, except on its growing edge. Calices are 0.8 to 1.4 mm in diameter, with wide walls. Corallites have a free triplet with all three septa about the same size. Lateral septa are fused in pairs and better developed than the rest. There are six to eight pali, and one or two denticles per septum, and the color of tissue is greenish-gray to dark brown. With this new species, the current total number of species in the genus *Porites* in the eastern Pacific reaches nine, with most species restricted to oceanic islands of the region.

In the last 20 years, taxonomic studies on the scleractinian zooxanthellate fauna of the eastern Pacific have noticeably increased in number and quality (Wells 1983, Guzmán & Cortés 1993, Hodgson 1995) and as a consequence, there is now fairly good agreement on coral identities since some key taxonomic problems have been resolved (Squires 1959, Wells 1983, Veron 1986). New research also has shown that the actual richness of coral species from the eastern Pacific is much higher than once thought [e.g., originally less than 20 species according to Veron (1993) and Paulay (1997)]. For example, México, Costa Rica and Panamá have 20 to 25 species each and almost 40 are known to inhabit western America (Holst & Guzmán 1993, Cortés & Guzmán 1998, Reyes-Bonilla & López-Pérez 1998). This perceived increase in richness comes from new records for particular localities or areas (e.g., Reyes-Bonilla 1992, Cortés & Guzmán 1998) and by

descriptions of new species (Budd & Guzmán 1994, Glynn 1999).

Members of the genus *Porites* Link, 1807 are widely distributed in the eastern Pacific, and they are one of the dominant corals in this region, both in abundance and species richness (Glynn 1997). To date, eight species have been reported: *P. australiensis* Vaughan, 1918, *P. baueri* Squires, 1959, *P. lichen* Dana, 1846, *P. lobata* Dana, 1846, *P. lutea* Milne Edwards, 1860, *P. panamensis* Verrill, 1866, *P. rus* Forskaal, 1775, and *P. sverdrupi* Durham, 1947 (Guzmán & Cortés 1993, Glynn 1997, Reyes-Bonilla 1999). Both *P. panamensis* and *P. lobata* are present in coral communities from the Galápagos Islands, or the Ecuadorian mainland, to México (Reyes-Bonilla 1993, Glynn 1997), while *P. sverdrupi* and *P. baueri* are endemic to the Gulf of California and the Marías Islands, México, respectively (Squires 1959, Reyes-Bonilla & López-Pérez 1998). *Porites rus* is an

Indo Pacific species that was reported from Costa Rica in the early 1980's, but its population may be extinct now (Glynn 1997, Cortés & Guzmán 1998). The remaining three species are Indo Pacific also, but they have been observed in the Revillagigedo Archipelago, México, a group of four oceanic islands located about 300 km southwest of the Baja California peninsula, or at Clipperton Island, the only true atoll of the eastern Pacific, 1300 km SW of the Mexican mainland (Glynn et al. 1996, Ketchum & Reyes-Bonilla 1997).

In this paper, a new species of *Porites* is described. This coral is distinctive because its colonies have been found exclusively in the oceanic Clipperton and Revillagigedo Islands, eastern Pacific. This finding increases the known number of species of the genus *Porites* to nine, a number even greater than that reported for the Atlantic-Caribbean area (Weil 1992, Veron 1993).

Abbreviations of repository institutions.—USNM: United States National Museum of Natural History, Department of Invertebrate Zoology, Smithsonian Institution, Washington, D.C. 20560, U.S.A.; MHNUABCS: Museo de Historia Natural de la Universidad Autónoma de Baja California Sur. Departamento de Biología Marina. La Paz, B.C.S., 23080, México; ECOCHBC: Colección de Corales de El Colegio de la Frontera Sur, Grupo de Ecología Bentónica. Apartado postal 424, Chetumal, Q. Roo, 77000, México. UMML: University of Miami Marine Laboratory. Rosenstiel School of Marine and Atmospheric Sciences. 4600 Rickenbacker Causeway, Miami, FL 33149, U.S.A.

Order Scleractinia Bourne, 1900
Suborder Fungiina Verrill, 1865
Superfamily Poritoidea Gray, 1842
Family Poritidae Gray, 1842
Genus *Porites* Link, 1807

Type species.—*Porites polymorphus* Link, 1807 = *Madrepora porites* Pallas, 1766 (in part).

Diagnosis.—Massive, ramose or encrusting cerioid coralla. Corallites with calices smaller than 2 mm in width, with two cycles of septa. Septa commonly bear spines and are formed by three or four trabeculae that in their innermost portions are differentiated as pali. A single trabecular columella, absent in certain species. Colony formation by extratentacular budding. Coenosteum poorly developed (Wells 1956).

Distribution.—The genus is circumtropical, recorded in the Pacific, Indian and Atlantic oceans, as well as in the Caribbean Sea (Veron 1993). Fossil records are known from the Cretaceous (?), Eocene to Recent, but are more abundant and dominant in reef communities since the Miocene (Wells 1956, Veron 1995). In the eastern Pacific the genus is distributed from the Galápagos Islands (0°N), Ecuador, to the northern Gulf of California (31°N), México, including all adjacent oceanic islands (Wells 1983, Reyes-Bonilla 1993).

Porites arnaudi, new species

Figs. 1–6

Etymology.—Named after Gustavo Arnaud Vignon, the last Commander in Chief of the Mexican Navy garrison on Clipperton Island, who died tragically while on duty on 1916.

Diagnosis.—(Terminology after Veron & Pichon 1982 and Veron 1986) Oval shaped colonies composed of tiered, thick plate-like laminae (at least 10 mm in width). Corallum originates from a single wide pedicel, with smooth, concave and undulated surfaces, with no living tissue on the inferior parts, except on its growing edges. Corallites distinct, calices 0.8 to 1.4 mm wide, with walls less than 1 mm wide. Septa rarely bifurcated. Free triplet, although the ventral directive and one lateral can be joined. Lateral septa fused in pairs and better developed than the rest. One or two conspicuous denticles in the inner part of each septum. Six to eight pali which do not reach the level of the wall; the palus of the triplet

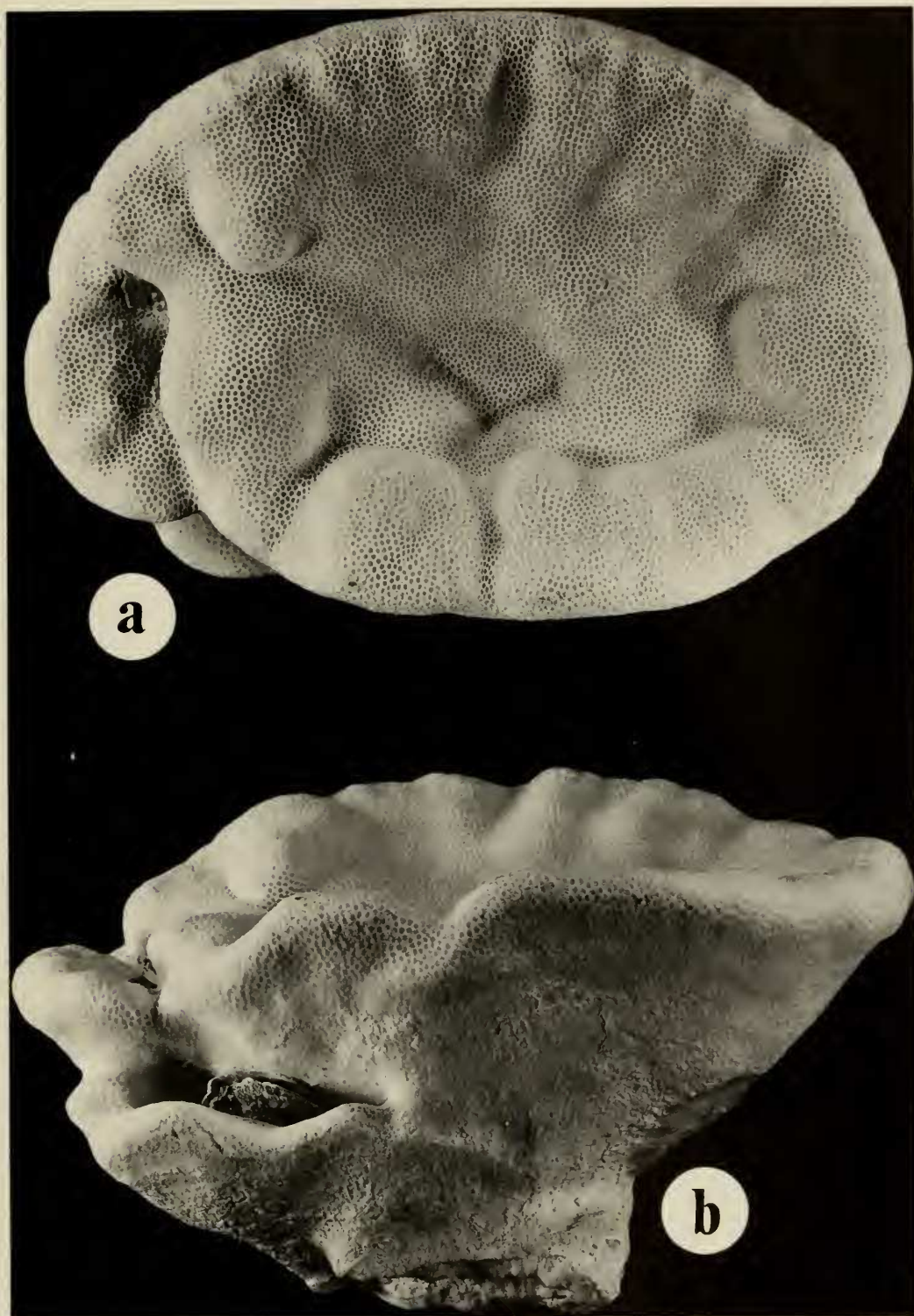


Fig. 1. *Porites arnaudi*, holotype, USNM 100261. Recent, 30 m depth, Clipperton Atoll, France. a, top view; b, side view. Both $\times 0.49$.

and dorsal directive less developed than those of the lateral pairs. Two synapticular rings, the external more defined. Living tissue color greenish-gray to dark brown, with pale margins.

Holotype.—USNM 100261 (Figs. 1a, b; 4a, b; 5a, b): length 213 mm, width 148 mm, height 111 mm, thickness of peripher-

ical edge of folia 19 to 21 mm; collected 25 Nov 1997 by Juan P. Carricart-Ganivet.

Paratypes.—ECOCHBC 0107 (Fig. 2a, b), MHNUABCS 1044, 1076, 1092, 1100, 1103, 1581 (Fig. 3c, d), 1582 (Fig. 3a, b), 1583, UMML 8.1475 (Fig. 6a, b).

Type locality.—Northeast seaward slope (sensu Glynn et al. 1996), off Clipperton

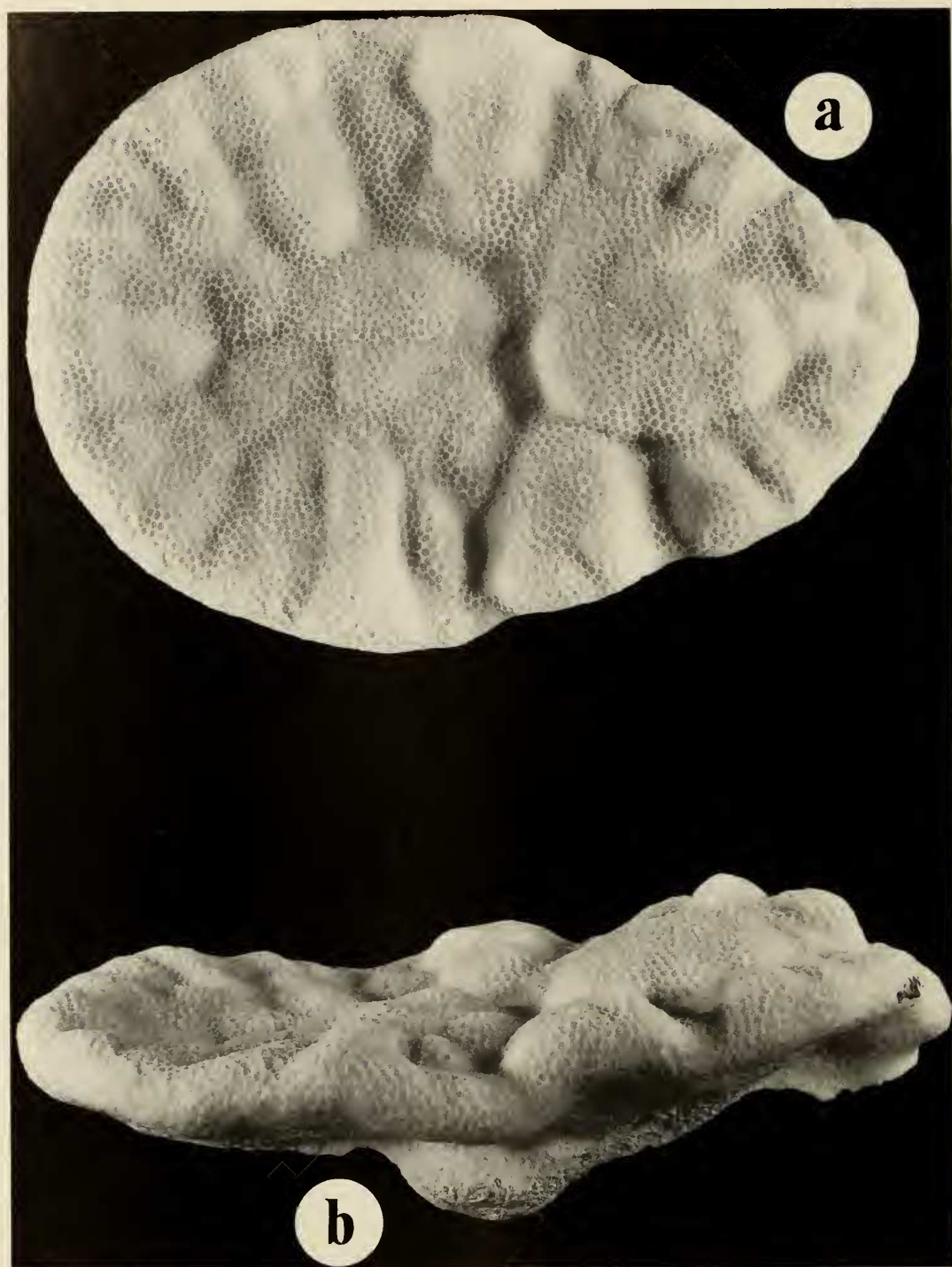


Fig. 2. *Porites arnaudi*, paratype, ECOCHBC 0107. Recent, 30 m depth, Clipperton Atoll, France. a, top view; b, side view. Both $\times 0.79$.

Atoll, France ($10^{\circ}18'N$, $109^{\circ}13'W$), at 30 m depth.

Description.—Colonies submassive, forming conspicuous tiered plates growing outwards from a central base (discoidal morphology; Figs. 1a, b; 2a, b); coralla can attain more than 40 cm in diameter and about 30 cm in height, being firmly attached to the substrate. Smooth, concave, and undulated upper surfaces, with thick fo-

lia at least 10 mm in width (Fig. 3a–d). Inferior surfaces devoid of living tissue except in their growing edges. Corallites 0.8 to 1.4 mm diameter, conspicuous, with deep, polygonal calices (normally five to six sides) having six to eight deep-set pali, which do not reach the level of the wall. Intercalicular distances 0.8 to 1.7 mm (Figs. 4a, b). Corallite walls less than 1 mm thick and composed of three rows of denticles.

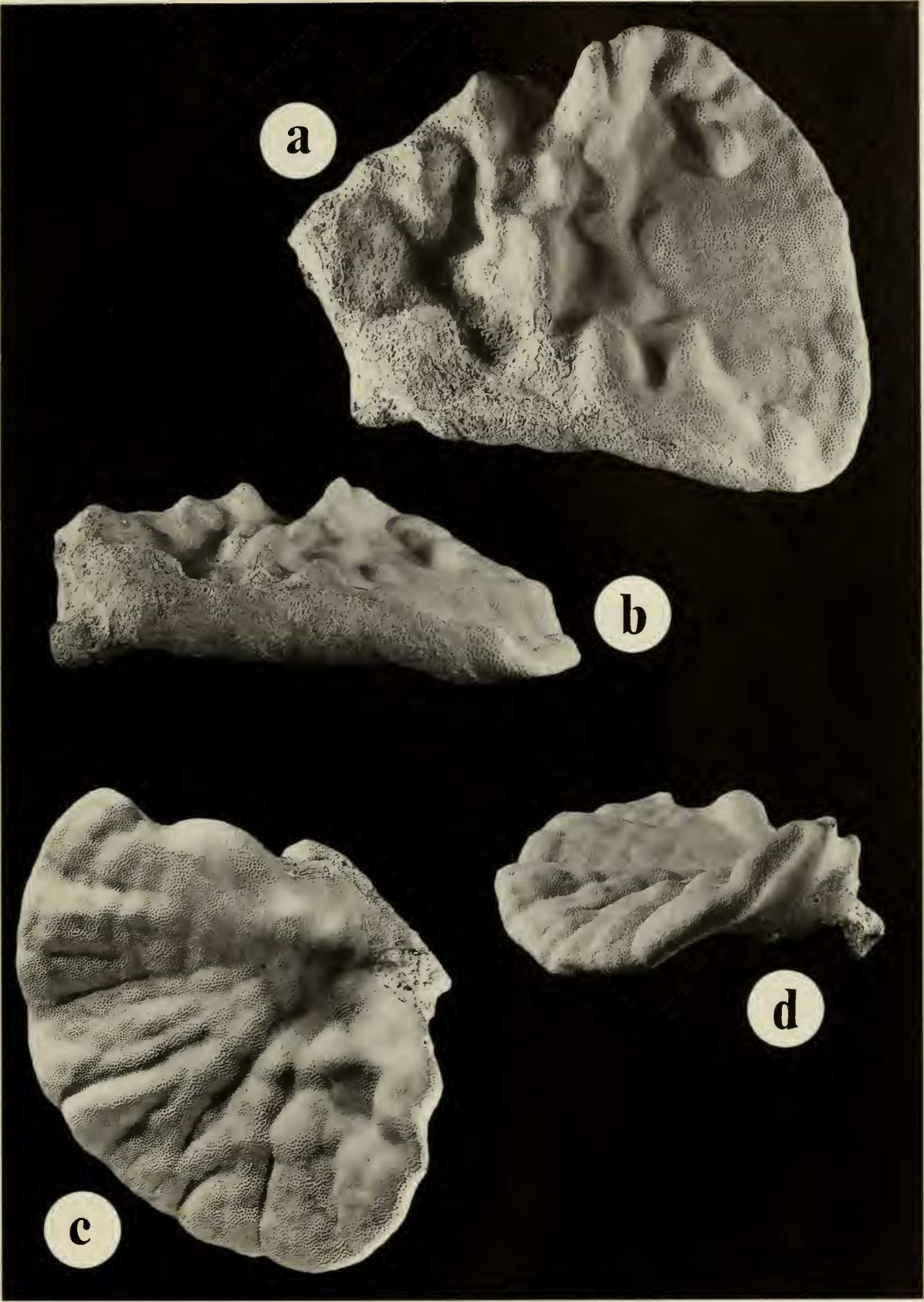


Fig. 3. *Porites arnaudi*, paratypes, top and side views of laminae from the edge of larger colonies: a, b, MHNUABCS 1582; c, d, MHNUABCS 1581. Both recent, 21 m depth, Clipperton Atoll, France. All figures $\times 0.30$.

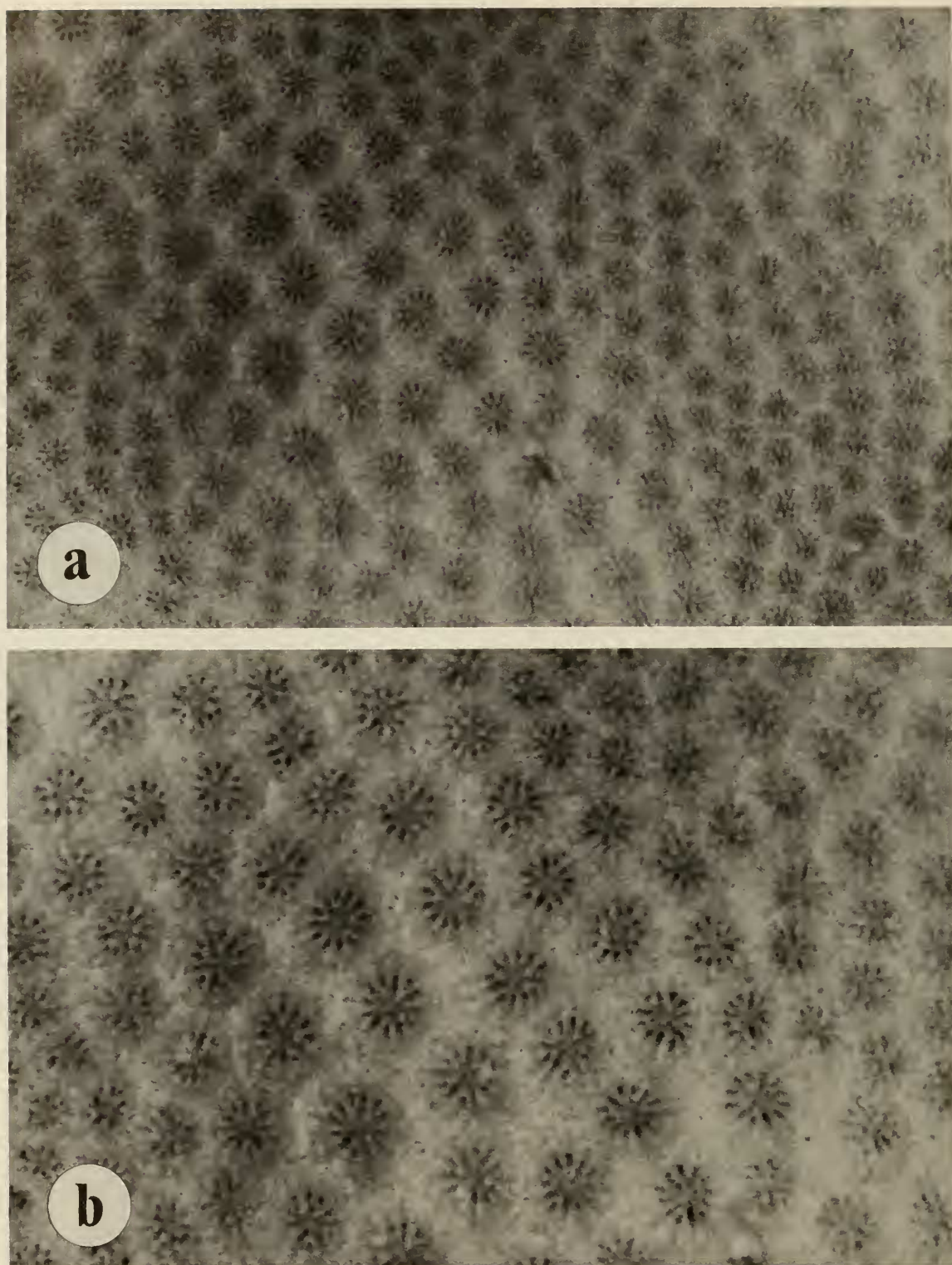


Fig. 4. *Porites arnaudi*, variation of skeletal structure in the holotype USNM 100261. Notice diagnostic characters such as polygonal calices and wide walls. a, $\times 6$; b, $\times 9$.

Twelve septa rarely bifurcated (Figs. 5a, b; 6a, b). The triplet normally has free margins, although it can also have the directive and a lateral septum (generally that of the right side) fused in the inner section. Lateral septa arranged in four fused pairs, better developed and longer than the rest, and in its

innermost portion presents conspicuous pali that rarely reach the level of the corallite wall. Pali of the triplet and the dorsal directive septa less developed than those of lateral pairs, or may be absent (Fig. 6a, b). One or two denticles per septum, which can resemble small pali because of extensive

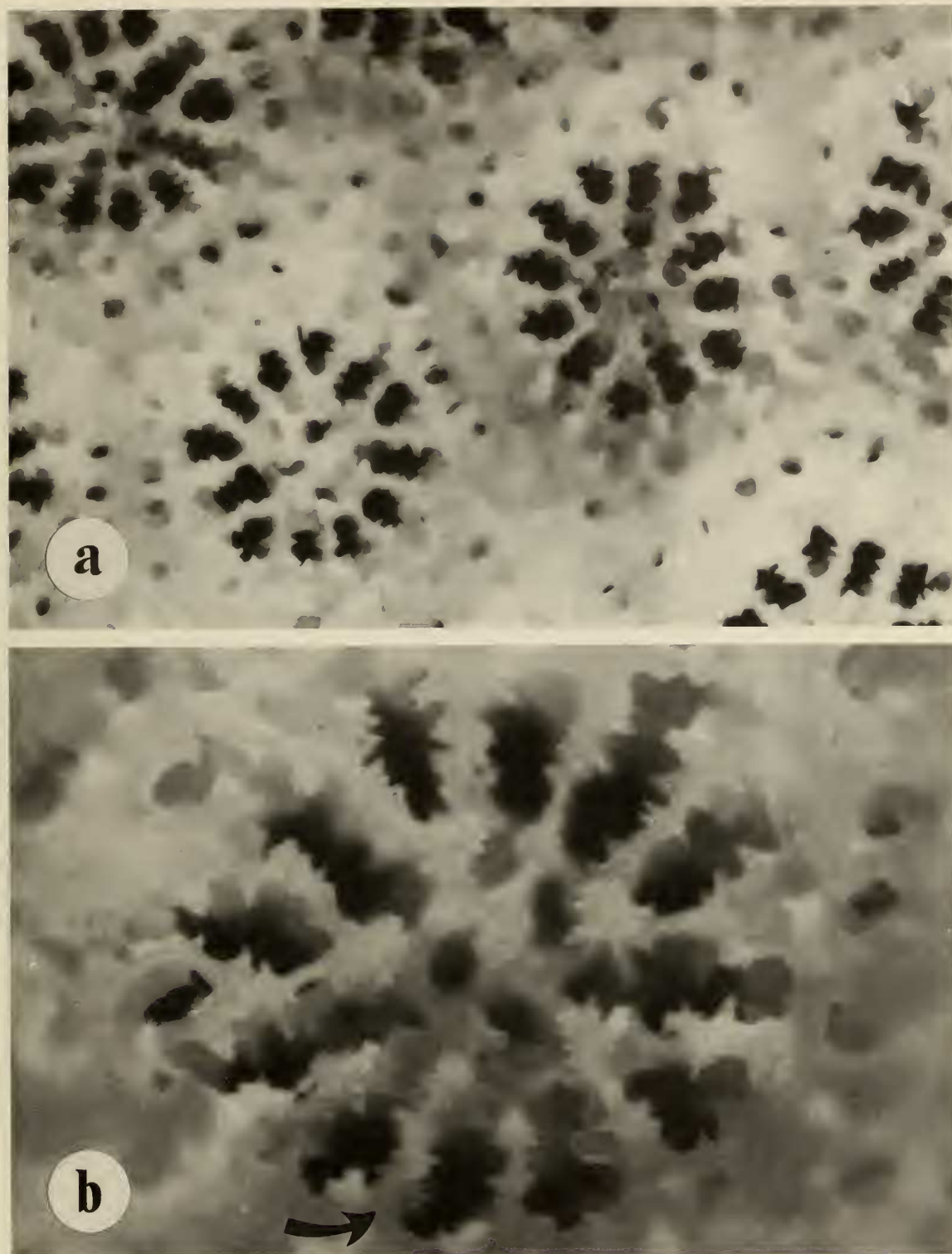


Fig. 5. *Porites arnaudi*, variation of skeletal structure in the holotype USNM 100261. Notice diagnostic characters such as prominent pali, inconspicuous columella, one denticle per septum and free triplet (arrow). a, $\times 34$; b, $\times 66$.

development and their position near the calicular center. Columella quite variable, sometimes appearing as a small column or stylet, may be compressed dorsoventrally, or may be absent. In some, a second prominent protuberance about the same size as the columella may be present near the inner

margin of the dorsal directive. Two synapticular rings, the external more defined than the inner palar. Tissue color from greenish-gray to dark brown, with pale margins.

Distribution.—This species was first recorded by Glynn et al. (1996) at Clipperton Atoll (southeast, northeast and southwest

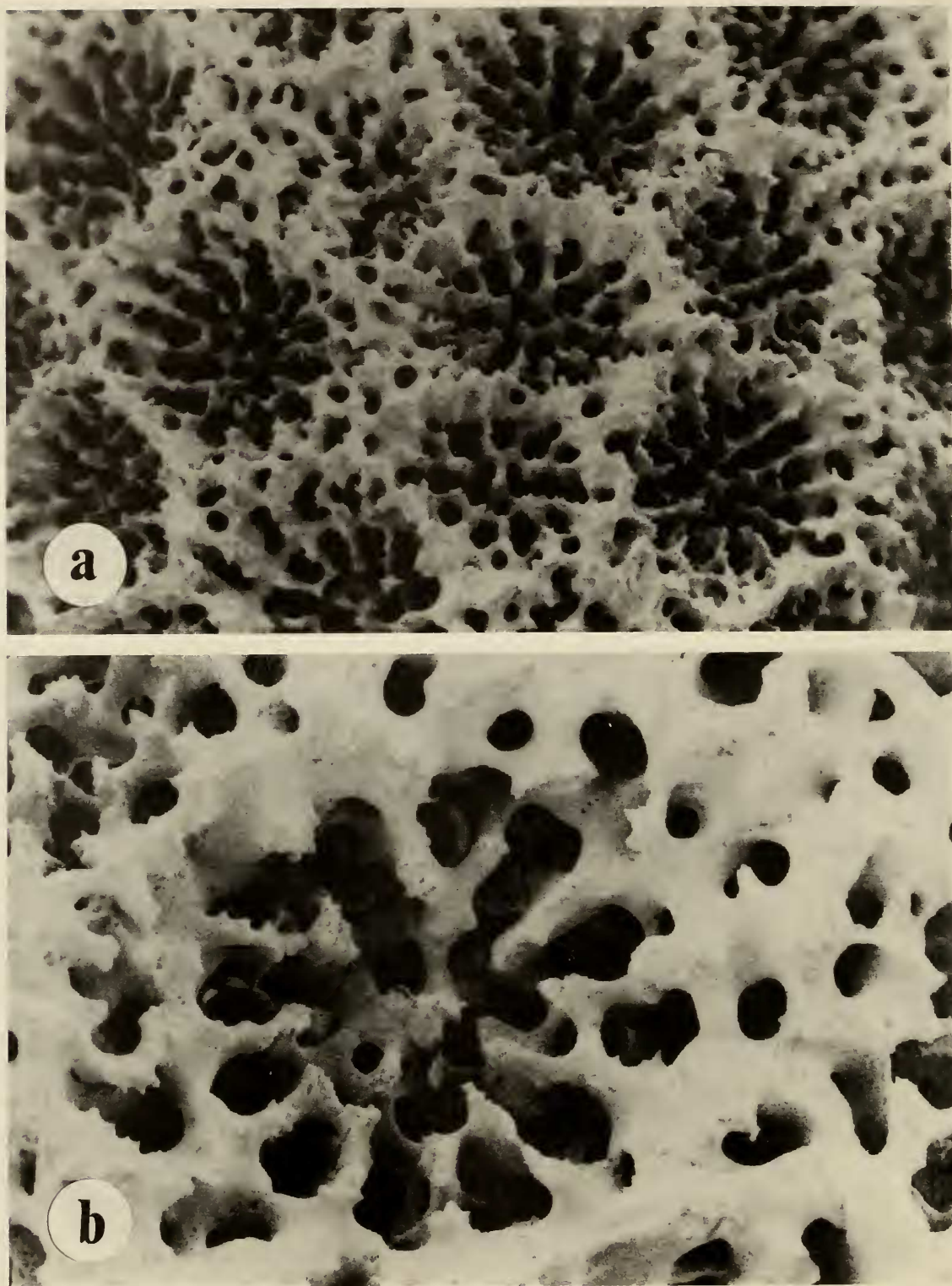


Fig. 6. *Porites arnaudi*, SEM photos of the paratype UMML 8.1475. Recent, 18 m depth, Clipperton Atoll, France. a, group of calices $\times 16$. b, single calice $\times 38$.

sites) and at San Benedicto ($19^{\circ}18'N$, $110^{\circ}48'W$) and Clarión islands ($18^{\circ}20'N$, $114^{\circ}44'W$), Revillagigedo Archipelago, under the name *Porites* sp. Later, Ketchum & Reyes-Bonilla (1997) confirmed its presence in San Benedicto and Clarión, and also at Socorro Island ($18^{\circ}45'N$; $111^{\circ}00'W$),

calling it *Porites* sp. 1. However, no exact locations of collection or observation sites were presented in those papers. The holotype (USNM 100261, collected by J. P. Carriart-Ganivet at 30 m depth, 25 Nov 1997) and six other specimens on which the current description is based (UMML 8.1475,

collected by P. W. Glynn at 18 m depth, 14–26 Apr 1994; ECOCHBC 0107 collected by A. Medina-Cárcamo at 30 m depth, 25 Nov 1997; MHNUABCS 1581, 1582, 1583 collected by H. Reyes-Bonilla at 21 m depth, 26 Nov 1997) were found in the “Poritid zone” (sensu Glynn et al. 1996), at the northeast seaward slope, Clipperton Atoll. Other coralla of the same species were sampled at Playa Norte and Punta Tosca (Socorro Island; 18°47′25″N, 111°01′15″W, MHNUABCS 1044, collected by J. F. Castellanos-Avila at 14 m depth, 30 Nov 1991), Bahía Azufre (Clarión Island; 18°20′47″N, 114°44′00″W, MHNUABCS 1092, 1100, 1103, collected by J. Ketchum at 7, 7 and 10 m depth, 15 Dec 1994) and Roca Trinidad (San Benedicto Island; 19°18′59″N, 110°49′00″W, MHNUABCS 1076, collected by H. Reyes-Bonilla at 15 m depth, 20 May 1995). As *Porites arnaudi* has not been observed elsewhere in the central Pacific or off American mainland, it is considered to be endemic of the oceanic Revillagigedos and Clipperton islands.

Ecology.—This newly described coral is distributed at depths from 7 to 37 m, especially in steep rocky slopes, and often overgrows adjacent coralla, mostly *Porites lobata* and *Pavona varians* Verrill, 1864 in Clipperton (Glynn et al. 1996) and *P. lobata* and *Psammocora superficialis* Gardiner, 1898 in the Revillagigedos. It is not abundant; Glynn et al. (1996) mentioned that percent live cover was up to 7.4% in the southeast side of Clipperton, while in the Revillagigedos it is seldom found, although it is locally abundant at Playa Norte (Socorro Island), Bahía Azufre (Clarión Island) and Roca Trinidad (San Benedicto Island). Coralla commonly shows bite marks in the outer edges of the plates, most likely produced by *Arothron meleagris* (Bloch & Schneider, 1801) or *Melichthys niger* (Bloch, 1786), both fishes that frequent localities where *Porites arnaudi* has been found (Allen & Robertson 1994, Robertson & Allen 1996). Bioeroders and serpulid polychaetes were rare in colonies of this

species observed at Clipperton and practically absent in those collected for this paper. In contrast, they were much more abundant in the Revillagigedos, in particular the bivalves *Lithophaga* spp., which commonly bore the bases of the plates.

Comparison.—Because *Porites arnaudi* has been found in Clipperton and at the Revillagigedo Archipelago, it must first be differentiated from all other conspecifics present in those localities: *P. lobata*, *P. lutea*, *P. lichen*, *P. australiensis* and *P. panamensis* (Ketchum & Reyes-Bonilla 1997, Reyes-Bonilla 1999). The coral here described is similar to *P. lobata*, as noted by Glynn et al. (1996), because both species have thick ledges with an inconspicuous columella, well developed dorsal directive septa and lateral pairs, palus of the dorsal directive septum smaller than those of the laterals, and septa of the triplet always free (Veron & Pichon 1982, Veron 1986; Figs. 5a, b; 6a, b). Notwithstanding, the former can be identified by its plate-like tiered colonies (Figs. 1a, b, 2a, b, 3a–d) which are not massive or hemispherical as in *P. lobata*. Also, it presents a well-defined syntactical ring and different tissue color (gray or brown in *P. arnaudi* and blue, purple or green in *P. lobata*). A third difference is that *P. lobata* has two denticles on each septum, whereas *P. arnaudi* normally has only one (Fig. 6b). *Porites arnaudi* and *P. lutea* differ noticeably because the latter is massive and has columniform lobes, shallow corallites and thin walls. In addition, in *P. lutea*, pali reach the level of the walls, all septa of the triplet are fused by a transverse rod or in their margins (in a “trident”), bifurcate septa often appear and columella is well developed. *Porites arnaudi* can be easily separated from *P. australiensis* because the latter has a large and well-developed columella and pali that reach the level of the wall denticles. Also, in the triplet, the former species has lateral septa about the same size as those of the ventral directive (Figs. 5a, b, 6a, b), while in *P. australiensis* the lateral septa are

smaller than those of the ventral directive, and occasionally have fused triplets instead of free ones. The morphology of the corallum is quite different also, as *P. australiensis* (like *P. lobata*) has massive, almost spherical colonies (Veron & Pichon 1982, Veron 1986). *Porites panamensis* can be distinguished from *P. arnaudi* principally because its colonies are very small (never larger than 40 cm height and diameter), encrusting, massive or columnar, and its color is bright green instead of gray or brown. Other differences are that *P. panamensis* has fewer pali (normally five) and thin walls (Squires 1959). *Porites lichen* is another species quite similar to *P. arnaudi*, having six to eight pali and wide walls, one denticle per septum, thick ledges around colony bases, or appearing as laminar plates (Veron & Pichon 1982, Veron 1986). Nevertheless, they can be differentiated on the basis of the corallites of *P. lichen* which have septa of the triplet commonly fused in their margins, while directive dorsal septa of the same structure are shorter than laterals. Also, coralla of this species appear as columnar colonies, and when they occur as laminae, these are thin and develop only in the base of the coralla, a character never presented in *P. arnaudi* (Figs. 1a, b, 2a, b, 3a–d).

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